

SUPPORT FOR THE AMENDMENTS

This Amendment cancels Claim 10; and amends Claims 1-7 and 9. Support for the amendments is found in the specification and claims as originally filed. In particular, support for the amendments is found in canceled Claim 10. No new matter would be introduced by entry of these amendments.

Upon entry of these amendments, Claims 1-9 will be pending in this application. Claim 1 is independent. Claims 6-8 are withdrawn from consideration.

REQUEST FOR RECONSIDERATION

Applicants respectfully request entry of the foregoing and reexamination and reconsideration of the application, as amended, in light of the remarks that follow.

Although conventional steel sheets combine high strength and excellent formability, conventional steel sheets having high strength are lacking in bendability (i.e., local ductility). See, e.g., specification at page 1, lines 15-16; page 1, line 26 to page 2, line 1; page 2, line 14 to page 3, line 1.

The present invention provides a TRIP (Transformation Induced Plasticity) steel sheet combining high strength and excellent bendability (i.e., local ductility). This combination of properties is achieved by the present invention using a specific two-stage heat treatment to control the number of carbide grains to no more than 40 per 2000 μm^2 between retained austenite and ferrite in the steel sheet. See, e.g., specification at page 1, lines 4-6; page 4, line 16 to page 5, line 12; page 6, line 11 to page 8, line 4.

Claims 1, 3-5 and 9-10 are rejected under 35 U.S.C. § 103(a) over Japanese Patent 2000319759 ("JP-759") or Japanese Patent 2000309853 ("JP-853"). Claim 2 is rejected under 35 U.S.C. § 103(a) over JP-759 or JP-853 and further in view of European patent

1201780 ("EP-780"). Claims 1-5 and 9-10 are rejected under 35 U.S.C. § 103(a) over EP-780.

JP-759 discloses a steel tube capable of withstanding complicated working such as hydroforming and excellent in workability by a bending roll system. The steel tube contains 0.05 to 0.25 wt% C, 0.5 to 2.5 wt% Si, 0.5 to 3.0 wt% Mn, ≤ 0.005 wt% S, ≤ 0.15 wt% P; 0.005 to 0.10 wt% Al, containing at need 0.0002 to 0.0020 wt% Ca, with a balance of iron with inevitable impurities. The steel tube has a composite structure composed of 5 to 15% of austenite metastable at ordinary temperatures, with a balance of martensite, bainite and ferrite. JP-759 at English-language abstract.

JP-853 discloses a steel tube excellent in workability on a low-strain forming system and capable of withstanding complicated working such as hydroforming. The steel tube consists of 0.05 to 0.20 wt% C, 0.5 to 2.0 wt% Si, 0.5 to 2.5 wt% Mn, ≤ 0.005 wt% S, ≤ 0.15 wt% P; 0.005 to 0.10 wt% Al, with a balance of iron with inevitable impurities and containing, if necessary, 0.0002 to 0.0020 wt% Ca. The steel tube has a structure consisting of ≥ 5% austenite metastable at ordinary temperatures and a balance of martensite, bainite and ferrite. JP-853 at abstract.

EP-780 discloses a conventional Dual Phase (DP) steel plate having excellent burring workability and fatigue strength. The steel plate contains 0.01 to 0.3 mass% C, 0.01 to 2 mass% Si, 0.05 to 3 mass% Mn, 0.1 mass% or less of P, 0.01 mass% or less of S and 0.005 to 1 mass% of Al. The steel has a microstructure having ferrite as the main phase and martensite or retained austenite mainly as the second phase. EP-780 at abstract. The second phase may also contain bainite and pearlite. EP-780 at [0026].

The differences between DP steel (e.g., EP-780) and TRIP steel (e.g., present invention) are discussed in Processing and Application Technology of Steel Material, The

175th & 176th Nishiyama Memorial Technical Seminar, The Iron and Steel Institute of Japan, November 2001 (copy attached, with English-language translation).

The steel sheet of EP-780 has a compound structure with ferrite as the main phase and martensite as the second phase. EP-780 at claim 1. Thus, the microstructure of the steel sheet of EP-780 is a Dual Phase (DP) structure of ferrite and martensite.

The maximum area % of martensite in the TRIP steel Inventive Examples of the present invention is 2% (see specification at page 16, Nos. 2-3 and 10).

In contrast, the minimum area % of martensite in the DP steel Inventive Examples of EP-780 is 6% (see page 13, Table 2, Inventive Example Q).

The TRIP steel sheet of the present invention has a structure comprising mainly ferrite and retained austenite. Because little carbon can be dissolved in the ferrite, the carbon in the steel matrix exists mainly in the retained austenite. As a result, the carbon concentration in the retained austenite is high and the retained austenite is stable in the TRIP steel.

When the carbon concentration in the retained austenite of TRIP steel becomes high, and concentrated carbon does not have enough time to diffuse, the carbon concentration at the side of retained austenite between ferrite and retained austenite increases. As the carbon concentration becomes high, carbide tends to form between the ferrite and retained austenite in TRIP steel. The present invention suppresses the formation of carbide between ferrite and retained austenite in TRIP steel.

The present invention reduces the carbide in the TRIP steel in order to obtain excellent bendability (i.e., local ductility). The prior art steel cannot have good bendability (i.e., local ductility) because bainite and martensite are hard phases. When these hard phases exist in a soft phase (e.g., ferrite), local ductility is reduced, especially at the location between the hard phase and soft phase.

As mentioned above, the maximum area % of martensite in the TRIP steel Inventive Examples of the present invention is 2%, while the minimum area % of martensite in the DP steel Inventive Examples of EP-780 is 6%. The area % of martensite in DP steel is usually larger than in TRIP steel. Furthermore, the size of martensite in DP steel is larger than the size of martensite in TRIP steel. See attached Second Declaration Under 37 C.F.R. § 1.132. As the size of martensite (hard phase) increases, the reduction in local ductility at the location between the hard phase and soft phase becomes more pronounced.

Accordingly, although DP steel such as that of EP-780 has good uniform ductility, the local ductility of the EP-780 steel is poor because of the existence of a hard phase in the soft phase.

The cited prior art is silent about carbide grains, which reduce bendability (e.g. local ductility). Each of JP-759, JP-853 and EP-780 is silent about the location of any carbide grains that might appear in their respective alloys. Because heat treatment affects the number and location of carbide grains, and the precise heat treatments used to prepare the steel disclosed in the prior art is not disclosed, it is impossible to determine the number of carbide grains between retained austenite and ferrite in the steels of the cited prior art. The independent Claim 1 limitation that "there exist no more than 40 carbide grains per 2000 μm^2 in the steel sheet between the retained austenite and the ferrite" is not inherent (i.e., necessarily present) in the cited prior art.

Because the cited prior art fails to suggest the independent Claim 1 limitation that "there exist no more than 40 carbide grains per 2000 μm^2 in the steel sheet between the retained austenite and the ferrite", the prior art rejections should be withdrawn.

Applicants respectfully request rejoinder of product Claim 6 with product Claims 1-5 and 9.

Pursuant to M.P.E.P. 821.04, after independent product Claim 1 is allowed, Applicants respectfully request examination and allowance of withdrawn Claims 6-8, which include all of the limitations of product Claim 1.

In view of the foregoing amendments and remarks, Applicants respectfully submit that the application is in condition for allowance. Applicants respectfully request favorable consideration and prompt allowance of the application.

Should the Examiner believe that anything further is necessary in order to place the application in even better condition for allowance, the Examiner is invited to contact Applicants' undersigned attorney at the telephone number listed below.

Respectfully submitted,

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Attached:

Processing and Application Technology of Steel Material, The 175th & 176th Nishiyama Memorial Technical Seminar, The Iron and Steel Institute of Japan, November 2001 (with English-language translation)

Second Declaration Under 37 C.F.R. § 1.132

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